



## Do Single-sex Educational Programmes in Stem Disciplines Reduce Drop-out Rate of Female Students?

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### Abstract

*Traditionally, female students and researchers are extremely underrepresented in mechanical engineering, computer science and comparable technical subjects in Germany and elsewhere [6, 7]. In universities, research organisations and universities of applied sciences as well as in research and development departments of the German industrial sector women are widely outnumbered by men when it comes to the study and professional exertion of the academic disciplines of science, technology, engineering and mathematics (=STEM). There has been a broad academic discussion about how to increase the percentage of women in the STEM disciplines. Also, many practical measures have been taken to achieve such an increase over the last 20 years [8]. In the federal state of Baden-Württemberg public funding is spent on single-sex educational programmes which, inter alia, are supposed to help reduce the drop-out rate of female students in some STEM disciplines. Both from the point of view of stakeholders who are interested in economic growth and therefore in the growth of well-skilled work force and from the point of view of supporters of gender equality, a higher quota of women in STEM is a desirable target. Netzwerk Frauen.Innovation.Technik is a group of women who, on behalf of the federal state government of Baden-Württemberg, regularly organise spring schools for female students and professionals of mechanical engineering as well as summer schools for female students and professionals of computer science. According to the concept of the educational programmes, courses are open for females only (single-sex education); during the events, accent is put not only on teaching hard and soft skills in technical subjects but also on networking activities. Professionally successful women are presented as role models, and individual mentoring and small learning groups are emphasised. Since 2002, these spring and summer schools were evaluated on a regular basis. The outcome indicates that the events did indeed contribute to a decrease in drop-out rates of female students. As a result, it can be said that single-sex educational programmes such as the ones mentioned above help raise the rate of females in traditionally male-dominated STEM disciplines.*

Keywords: Women in STEM; single-sex educational programmes; drop-out rate; mechanical engineering; computer science; female researchers

### 1. Introduction

In Germany, there are no tuition fees for European students in most of the federal states. Therefore, students can drop out of their studies without suffering major financial loss.

The German DZHW drop-out study [1] shows that the drop-out rates in the mathematics/natural sciences and engineering departments are particularly high: In natural sciences in 2010/11 34% of men and 27% of women abandoned their studies. In 2008/09, 38% of men and 37% of women studying mathematics/natural sciences, dropped out. In 2010/11, 40% of men dropped out, while the drop-out rate of women declined significantly to 33%.

This could be due to the numerous measures for the promotion of women, which are intended to motivate young women to study in STEM disciplines in particular. Whether these measures also contribute to the reduction of the drop-out rates is examined hereinafter.

#### 1.1 Research question

In Germany, there are still far fewer women than men in STEM disciplines, e.g. in the field of electrical and information technology, in the winter semester 2016/17 out of 85,638 students only 11,166 (i.e. 13%) were women [2].

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In such a male-dominated environment, women can encounter additional malpractices in addition to the gender-independent problems, such as performance pressure or false expectations regarding their studies: they are often prejudiced by male fellow students or lecturers, feel discriminated as a minority, are not taken seriously or have to contend with sexual harassment. For some women, these experiences are so uncomfortable that they consider dropping out of their studies [4].

Measures to promote equal opportunities for women in STEM disciplines therefore not only back up women with regard to technical and scientific content, but also provide social support. Most of the educational programmes meant to address gender-specific issues are offered exclusively for women.

Therefore, in order to assess these measures it is appropriate to find out whether single-sex educational programmes in STEM disciplines reduce the drop-out rate of female students.

## 1.2 Current state of research

The low interest of women in STEM disciplines in Germany is often attributed to the fact that young women are likely to let themselves be influenced by existing gender stereotypes when choosing their hobbies and professions [3].

Co-educational courses of study can foster a tendency of men to show a competitive attitude towards women [4]. Women find it more difficult to connect to a learning group and such individualization can also result in performance problems. Those and the lack of previous knowledge, however, are mentioned in gender-independent studies as the most common reason for drop-out [1].

To relieve women from the gender related difficulties in STEM disciplines, which add to performance pressure, supporting measures are tailored to raise their self-esteem and self-confidence by presenting female role models and by offering networking opportunities and single-sex educational programmes. Self-esteem and self-confidence are essential prerequisites for women to be successful in their STEM careers [5].

It can be assumed that the better a woman can deal with the aforementioned social aspects and the more successful she is in her studies, the less likely it is that she will drop out. This assumption will be revised below.

## 2. Methodology

To answer the above-mentioned questions, it is helpful to look at a long-time educational study that has been performed by a project group in the federal state of Baden-Württemberg in the south of Germany.

### 2.1 Setting of study

Netzwerk Frauen.Innovation.Technik is a group of women who, on behalf of the federal state government of Baden-Württemberg, regularly organise spring schools called *meccanica femminile (mf)* for female students and professionals of mechanical engineering as well as summer schools called *informatica femminile Baden-Württemberg (if)* for female students and professionals of computer science. *If* was launched in 2001 and in 2010, *mf* was added to it.

According to the concept of these educational programmes, courses are open for females only. The *if* and *mf* events are single-sex educational programmes meant to support female students and professionals in their pursuit of STEM careers. All teachers are females. During the events, emphasis is put not only on teaching hard and soft skills in technical subjects but also on networking activities. Professionally successful women are presented as role models, and individual mentoring and small learning groups are highlighted.

### 2.2 Evaluation of questionnaires

As a part of the evaluation of the spring and summer schools, students as well as teachers are asked to answer some questions about a range of aspects concerning the events, starting from how they found out about the event, the reason for their participation, through to how they felt about the single-sex character of the event and to their general assessment of every individual course and of the entire event.

In 2012, questions about course drop-out were included in the questionnaires for participants. Ever since then, at every event participants were enquired if they had ever thought of dropping their studies, and if so, for which reasons; also, they were asked why they finally decided to continue their studies. So, for 6



years data from female students of mechanical engineering and computer science concerning their decisions regarding study drop-out was gathered, in order to be statistically evaluated.

### 3. Results

The evaluation of the *if* and *mf* summer/spring schools' surveys from 2012 to 2017 reveals that an average of 27% of the participants have considered dropping out of their studies of mechanical engineering or computer science before reaching a degree. This percentage is in line with the general study drop-out numbers cited above [1].

An average of 34.7% of participants agreed to the phrase "In my opinion events such as *informatica femminile* can prevent female students from dropping out of their studies." An average of 8.6% of participants even stated that the participation in *if* or *mf* motivated them to continue their studies.

In absolute numbers: over the years, 17.6% of female STEM students per event stated having thought about drop-out. Also, 6.2% students per event (i.e. 12.4% per year) indicate that participation in the event *if* or *mf* has motivated them to continue their studies. So, attending one of the single-sex educational programmes contributed to changing the mind of nearly a third of female students who had considered a study drop-out before [Fig.1].

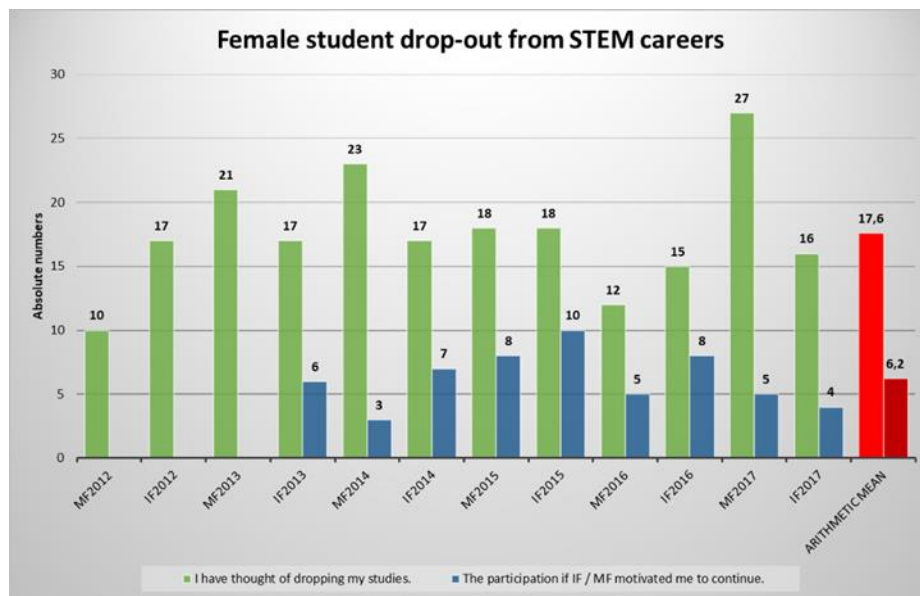


Figure 1: The red bars depict the mean values for the blue and green bars.

### 4. Conclusion

It can be said that the single-sex spring/summer schools *mf* and *if* do play an important role in preventing participants of *mf* and *if* from dropping out of their studies.

The reasons for this, however, need further discussion. What is it exactly that makes female STEM students reconsider their idea of dropping their careers when they attend an event such as *mf* or *if*? Is it really the fact that it is an event for females only that makes the difference? Or is it just that the main reason for study drop-out – performance requirements during the first phase of studies are too exigent and previous knowledge of first-year students in mathematics, natural sciences, time management and independent working is insufficient [1] – are remedied by these spring/summer schools in general? They provide extra courses in core skills and in self-management, independent working and learning, academic research etc., so that participants can improve their knowledge of decisive skills, regardless of their gender.

Participants of *if* and *mf* who stated that they were motivated by the event not to drop their studies were not directly asked whether their decision to continue their studies had anything to do with the event being for women only. However, a closer look at the data reveals that women, who had stated that they were motivated by the event not to drop their studies, agreed to a greater extent to the phrase "It is important for



me that *informatica femminile Baden-Württemberg* is a single-sex event” than women, who did not feel motivated by the event to continue their studies. In general, women who were positive about the events being a motivation for them to continue their studies were also positive about the events being single-sex events.

This gives reason to assume that the events *if* and *mf* can motivate young female students of STEM disciplines to continue their studies exactly *because* they are single-sex programmes. These programmes make women feel better and more self-confident with their technical interest and provide them with a network of female colleagues that protects them against gender stereotyped prejudices in a male-dominated environment.

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